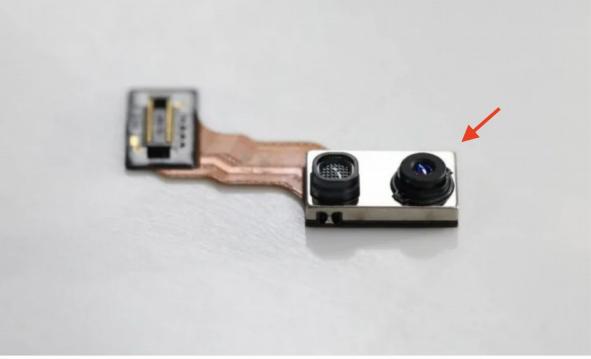


# Exhibit 5

**LG – Mobile Device (Smartphones and Tablets models with IR Time-of-Flight sensor/camera to support Gesture Recognition such as Air Motion, Face ID, Hand ID, and/or Gesture Shot features. See Product List at end for models)**

### Infringement of the '413 patent

Claim 9	Evidence
9. A method of measuring the magnitude of electromagnetic radiation in a selected location by a mobile communication device, consisting of the steps of:	<p>The LG mobile device performs a method of measuring the magnitude of electromagnetic radiation in a selected location.</p> <p>For example, when gesture recognition features such as Air Motion, Face ID, Hand ID, and/or Gesture Shot of the mobile device are used, the mobile device measures the magnitude and time delay of infrared electromagnetic radiation received by the mobile device's Time-of-Flight sensor at the location at which the front-facing camera is aimed.</p> <p><b>LG explains how the G8 ThinQ's tiny gesture sensor works</b></p> <p>It could also work in a car to control your AC and GPS with hand gestures.</p>  <p>[1]</p>



Steve Dent | @stevetdent | February 20, 2019 8:41 AM

LG has revealed more details about the "Time of Flight" sensor that will likely power the [G8 ThinQ](#)'s [touchless gestures](#). Built by LG's Innotek division, it reflects infrared light off of a subject, measures how long it takes to return and uses the data to calculate depth. LG said that the tech works over "long" distances, while consuming less power than other 3D tech. As such, it's suitable for face detection ID tech, motion sensing, AR, and more.

It differs from Apple's TrueDepth Face ID tech, which beams thousands of laser dots at a subject, then measures the distortion to calculate depth. Time of Flight, by contrast, measures distances like radar, and is similar to what Microsoft used in its [Xbox One Kinect](#). It can, in theory, deliver more accurate results for biometric scans, augmented reality and more.

[1]

# LG G Pad 7.0<sup>LTE</sup>

press a volume key to take a photo



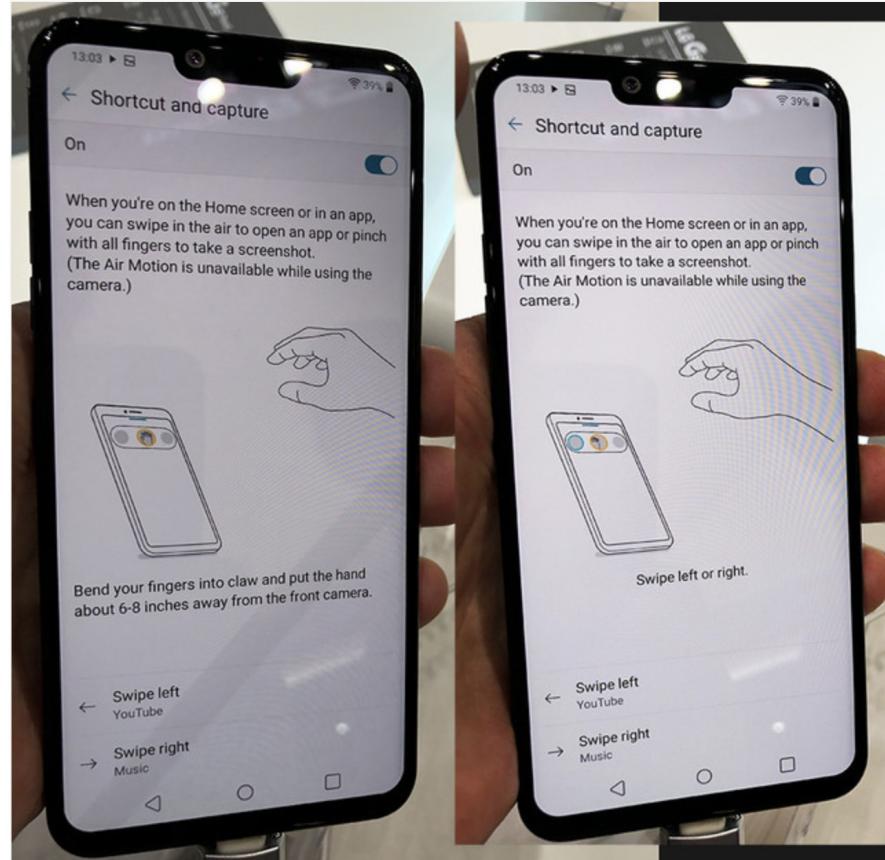
- Gesture Shutter<sup>2</sup> – take selfies with a simple hand gesture
- Image Editor – choose from multiple options to enhance your photos such as adding filters and frames, adjusting contrast and brightness, and more
- Video Resolutions: full HD up to 1920 x 1080<sup>1</sup>
- Pause & Resume Recording – pause and start in record mode for one continuous video file
- Live Shot – take still shots while recording video
- Live Zooming – zoom in/out on videos during playback
- Geotagging – include location information with photos and videos

<sup>1</sup> Available only on rear-facing camera or camcorder.

<sup>2</sup> Available only on front-facing camera or camcorder.

[3]

Another use is "Hand ID". Everyone has a distinctive hand and hand movements, LG said, and can differentiate between users, since the ToF sensor is mapping your veins. Hmm, you may be thinking. As I did.

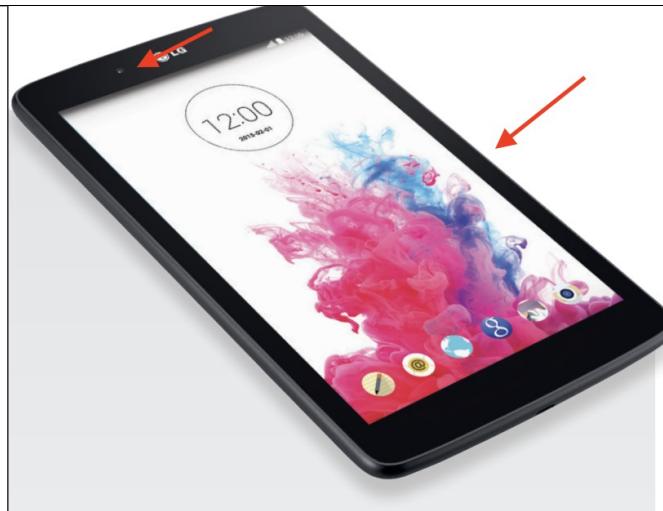


LG AirMotion UI. Click to enlarge

[4]

	<p>The "Air Motion" UI, which found in its new V50 ThinQ 5G and LG G8, requires you to draw shapes with your hand over the phone. It was like playing an invisible theremin. But it was hard to master and unreliable.</p> <p>The phones use Infineon's "time-of-flight" (ToF) 3D sensor, <u>unveiled</u> a couple of weeks ago and technically <u>very interesting</u>.</p> <p>[4]</p>
providing a mobile communication device that comprises a housing, a digital imaging sensor having a first field of view, such sensor is for generating a digital image of the selected location,	<p>The LG mobile device further provides a mobile communication device that comprises a housing and a digital imaging sensor having a first field of view. The sensor is for generating a digital image of the selected location.</p> <p>For example, the mobile device includes a housing for enclosing a digital image sensor, among other components of the mobile device. The digital image sensor has a field of view (e.g. outwards from the front of the mobile device) and is for generating a digital image of a subject or location at which it is aimed.</p> <p>For example the LG G8 ThinQ has 8.1 MP CMOS image sensor (front facing camera) within a housing.</p>

	<p>LG LMG820QM5 G8 ThinQ TD-LTE US G820QM / LMG820QM7D (LG Alpha Prime)</p> <p>[2]</p> <p>Secondary Camera System ⓘ</p> <table border="1"><tr><td>Secondary Camera Placement</td><td>Front ⓘ</td></tr><tr><td>Secondary Camera Sensor</td><td>CMOS ⓘ</td></tr><tr><td>Secondary Camera Number of pixels</td><td>8.1 MP sec. cam pixels ⓘ</td></tr><tr><td>Secondary Aperture (W)</td><td>f/1.90</td></tr><tr><td>Secondary Camera Focus</td><td>PD AF ⓘ</td></tr><tr><td>Secondary Video Recording</td><td>1920x1080 pixel 30 fps ⓘ</td></tr><tr><td>Secondary Camera Extra Functions</td><td>Burst mode , Panorama Photo , Face detection</td></tr><tr><td>Sec. Aux. Cam. Image Sensor</td><td>Mono CMOS ⓘ</td></tr></table> <p>[2]</p> <p>For example the LG GPAD 7.0 LTE tablet has 1.3 MP CMOS image sensor (front facing camera) within a housing.</p>	Secondary Camera Placement	Front ⓘ	Secondary Camera Sensor	CMOS ⓘ	Secondary Camera Number of pixels	8.1 MP sec. cam pixels ⓘ	Secondary Aperture (W)	f/1.90	Secondary Camera Focus	PD AF ⓘ	Secondary Video Recording	1920x1080 pixel 30 fps ⓘ	Secondary Camera Extra Functions	Burst mode , Panorama Photo , Face detection	Sec. Aux. Cam. Image Sensor	Mono CMOS ⓘ
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Secondary Camera Extra Functions	Burst mode , Panorama Photo , Face detection																
Sec. Aux. Cam. Image Sensor	Mono CMOS ⓘ																



[3]

**Camera/Video** ←

- 5 Megapixel Rear-Facing Camera
- 1.3 Megapixel Front-Facing Camera with Soft Light Setting
- Camera Resolutions: up to 2560 x 1920<sup>1</sup> (2560 x 1600 default)
- Shot Mode – choose from Panorama<sup>1</sup> and Auto
- Timer – set shutter/record delay to 3 or 10 seconds
- Zoom<sup>1</sup> – up to 4x
- Multiple Shutter Options – tap the shutter, use your voice, or

[3]

a computational means,

The LG mobile device further provides a computational means.

For example, the CPU device includes a main processor for performing computational processing.

For example the LG G8 ThinQ smartphone includes a Qualcomm Snapdragon CPU device:

	<p><b># Application processor, Chipset:</b></p> <table border="1" data-bbox="639 262 1501 388"> <tr> <td>CPU Clock ⓘ</td><td>2842 MHz</td></tr> <tr> <td>CPU ⓘ</td><td>Qualcomm Snapdragon 855 SM8150 (Hana),</td></tr> </table> <p><b># Operative Memory:</b></p> <table border="1" data-bbox="639 442 1501 567"> <tr> <td>RAM Type ⓘ</td><td>LPDDR4x SDRAM</td></tr> <tr> <td></td><td>2133 MHz ⓘ</td></tr> <tr> <td>RAM Capacity (converted) ⓘ</td><td>6 GiB RAM</td></tr> </table> <p>[2] For example the LG GPAD 7.0 LTE tablet includes a Qualcomm Snapdragon CPU device:</p> <div style="background-color: #f0f0f0; padding: 10px;"> <p><b>Key Features</b></p> <ul style="list-style-type: none"> <li>.....</li> <li>Vivid 7.0" HD+ IPS Display (1280 x 800)</li> <li>.....</li> <li>5 MP Camera</li> <li>.....</li> <li>Qualcomm® Snapdragon™ 400 1.2 GHz Quad-Core Processor</li> <li>.....</li> <li>Long-Lasting 4,000 mAh Battery</li> <li>.....</li> <li>QPair™ Links to Android™ Smartphones for Tandem Use*</li> <li>.....</li> </ul> </div> <p>[3]</p>	CPU Clock ⓘ	2842 MHz	CPU ⓘ	Qualcomm Snapdragon 855 SM8150 (Hana),	RAM Type ⓘ	LPDDR4x SDRAM		2133 MHz ⓘ	RAM Capacity (converted) ⓘ	6 GiB RAM
CPU Clock ⓘ	2842 MHz										
CPU ⓘ	Qualcomm Snapdragon 855 SM8150 (Hana),										
RAM Type ⓘ	LPDDR4x SDRAM										
	2133 MHz ⓘ										
RAM Capacity (converted) ⓘ	6 GiB RAM										
and an output means for conveying information to an operator;	<p>The LG mobile device further provides an output means for conveying information to an operator.</p> <p>For example, the mobile device also includes a touchscreen display for conveying information to an operator.</p>										

	<p>For example the LG G8 ThinQ includes an AM-OLED touchscreen display:</p> <p>❖ Display ⓘ ←</p> <table border="1"> <tbody> <tr><td>Display Notch ⓘ</td><td>1-notch</td></tr> <tr><td>Display Diagonal ⓘ</td><td>154.6 mm</td></tr> <tr><td></td><td>6.1 inch ⓘ</td></tr> <tr><td>Resolution ⓘ</td><td>1440x3120</td></tr> <tr><td>Horizontal Full Bezel Width ⓘ</td><td>7.01 mm</td></tr> <tr><td>Display Area Utilization ⓘ</td><td>83.4%</td></tr> <tr><td>Pixel Density ⓘ</td><td>565 PPI ↗</td></tr> <tr><td>Display Type ⓘ</td><td>AM-OLED ⓘ display</td></tr> <tr><td>Number of Display Scales ⓘ</td><td>1073.7M</td></tr> <tr><td>Scratch Resistant Screen ⓘ</td><td>Gorilla Glass 5</td></tr> </tbody> </table> <p>[2]</p> <p>For example the LG GPAD 7.0 LTE tablet includes a 7.0" HD+ IPS display:</p> <p><b>Interactivity</b></p> <ul style="list-style-type: none"> <li>• 7.0" HD+ IPS Display with Gorilla® Glass 3 Protection</li> <li>• QuickRemote™ – control compatible TVs and cable provider set-top boxes</li> <li>• Smart Screen – display setting keeps the screen active when tablet detects a face</li> <li>• Video Player with Touch Lock and Resume Play Function; supports MP4, H.263, H.264, VC-1, WMV, DivX, VP8, Theora</li> <li>• Music Player with Sleep Timer and Custom Audio Effects; supports MP3, AAC, eAAC+, WAV, WMA/WMV, FLAC</li> </ul> <p>[3]</p>	Display Notch ⓘ	1-notch	Display Diagonal ⓘ	154.6 mm		6.1 inch ⓘ	Resolution ⓘ	1440x3120	Horizontal Full Bezel Width ⓘ	7.01 mm	Display Area Utilization ⓘ	83.4%	Pixel Density ⓘ	565 PPI ↗	Display Type ⓘ	AM-OLED ⓘ display	Number of Display Scales ⓘ	1073.7M	Scratch Resistant Screen ⓘ	Gorilla Glass 5
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Display Type ⓘ	AM-OLED ⓘ display																				
Number of Display Scales ⓘ	1073.7M																				
Scratch Resistant Screen ⓘ	Gorilla Glass 5																				
incorporating into the housing a module that is responsive to intensity of the electromagnetic radiation in a selected spectral range;	<p>The LG mobile device incorporates into the housing a module that is responsive to intensity of the electromagnetic radiation in a selected spectral range.</p> <p>For example, the time-of-flight sensor in the mobile device is responsive to electromagnetic radiation in the infrared range and is enclosed in the mobile</p>																				

device's housing.

LG has been having a low-key Mobile World Congress, but its most eye-catching feature has been an attempt to implement waving your hands about as a method of interacting with its smartphone. It was immediately apparent why this hasn't come to market earlier.

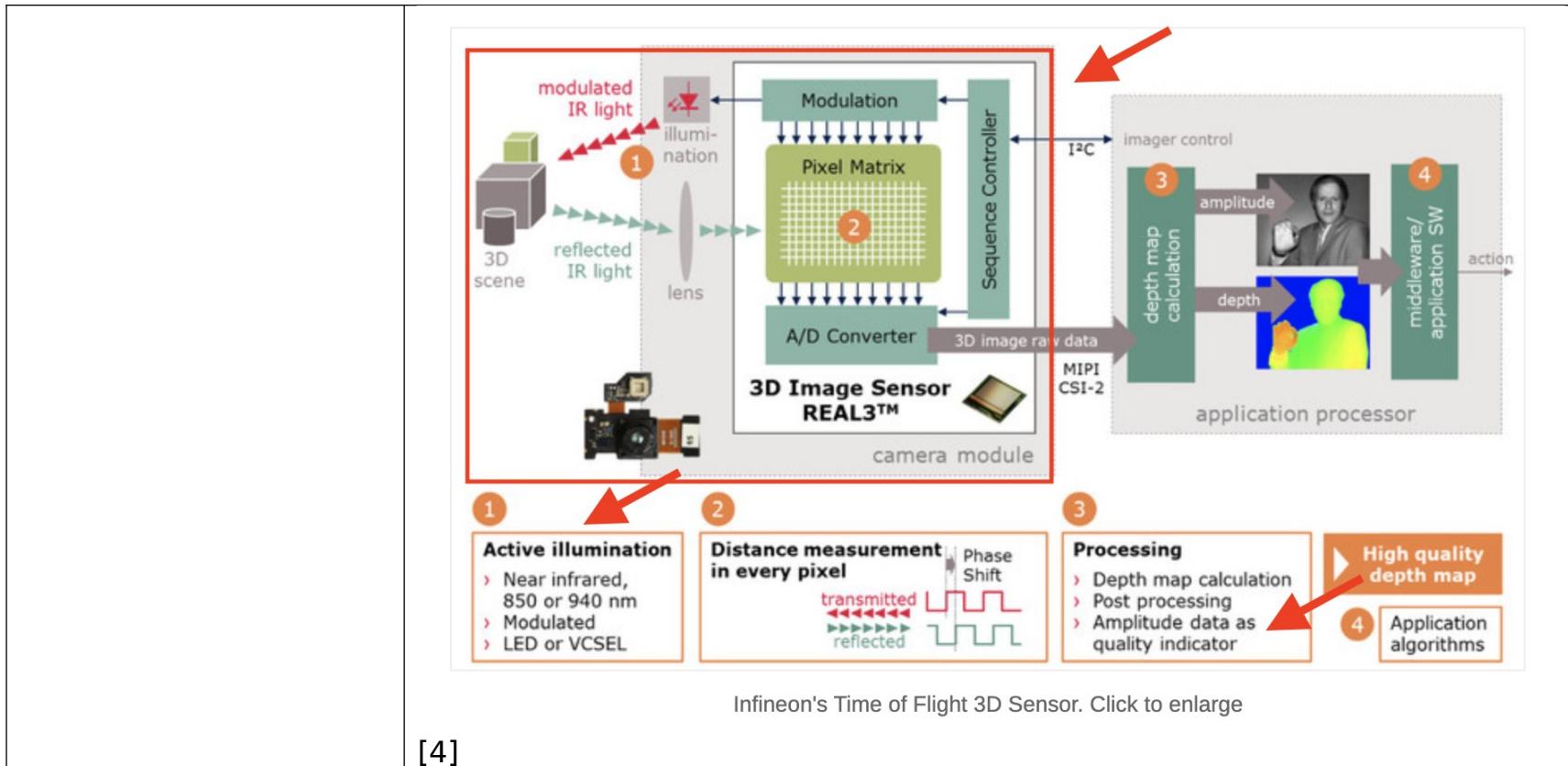
The "Air Motion" UI, which found in its new V50 ThinQ 5G and LG G8, requires you to draw shapes with your hand over the phone. It was like playing an invisible theremin. But it was hard to master and unreliable.

The phones use Infineon's "time-of-flight" (ToF) 3D sensor, unveiled a couple of weeks ago and technically very interesting.

[4]

At first glance, the G8 ThinQ looks a lot like the G7 ThinQ, but there's more to their similar metal and glass constructions. Housed inside of the notch is a new camera sensor that recognizes hand gesture and can be used to control features like the volume, calls, and media playback.

[5]



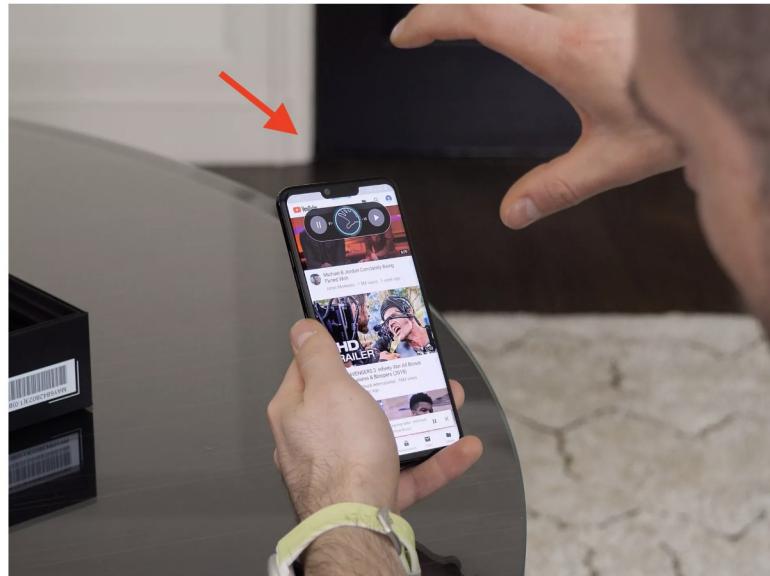
[4]

	 <p>press a volume key to take a photo</p> <ul style="list-style-type: none"> <li>• <u>Gesture Shutter</u><sup>2</sup> – take selfies with a simple hand gesture</li> <li>• Image Editor – choose from multiple options to enhance your photos such as adding filters and frames, adjusting contrast and brightness, and more</li> <li>• Video Resolutions: full HD up to 1920 x 1080<sup>1</sup></li> <li>• Pause &amp; Resume Recording – pause and start in record mode for one continuous video file</li> <li>• Live Shot – take still shots while recording video</li> <li>• Live Zooming – zoom in/out on videos during playback</li> <li>• Geotagging – include location information with photos and videos</li> </ul> <p><sup>1</sup> Available only on rear-facing camera or camcorder.  <sup>2</sup> Available only on front-facing camera or camcorder.</p> <p>[3]</p>
positioning the housing in a vicinity of the selected location;	<p>As directed by marketing and operational instructions, a user of the LG mobile device positions the housing in a vicinity of the selected location when using the gesture recognition features such as Air Motion, Face ID, Hand ID, and/or Gesture Shot.</p> <p>For example, an end user or LG test engineer, positions the mobile device such that it is in the vicinity of an external subject such as a hand or face.</p> <p>For example, when using the Air Motion feature, the LG G8 ThinQ smartphone is positioned with the front camera facing, and about 5" away</p>

from, the user's hand that is making gestures.

## How to use Air Motion on the LG G8

By Hayato Huseman published April 12, 2019



LG G8 Air Motion gestures (Image credit: Android Central)

[6]

The G8's handy new Time of Flight sensor and infrared light within the Z Camera system allow for what LG calls Air Motion — essentially a handful of gesture-based controls that let you quickly jump into app shortcuts, control music playback, and take screenshots, all without having to touch the phone. Here's how to make the most of it.

[6]

With Air Motion enabled, you can launch it by holding your hand about 3-5 inches away from the Z Camera sensors. You'll see a colorful line appear under the display notch, indicating Air Motion has been activated. From there, bring your fingers closer together to **form a claw-like shape** — if you have it enabled, the hand guide will appear, tracking your fingers and awaiting your gestures.

[6]

For example, when using the Gesture Shot/Shutter feature, the LG GPAD 7.0 LTE tablet is positioned with the front camera facing, and close to, the user's hand that is making gestures.

## **Gesture shot** ←

The Gesture shot feature allows you to take a picture with a hand gesture using the front camera.

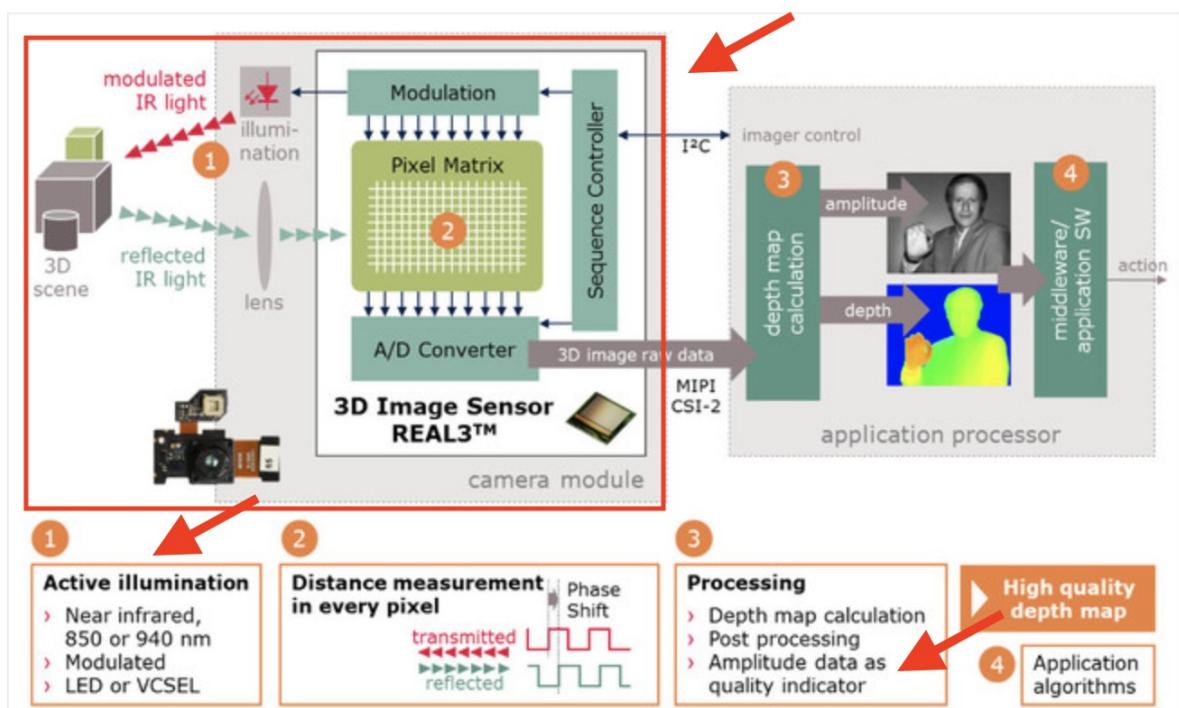
### **To take a photo with a gesture**

1. Activate the front camera lens.
2. Raise your hand, with an open palm, until the front camera detects it (a box appears on the screen).
3. Make a fist to start a countdown before the shot is taken (allowing you time to position yourself).

[7]

	 <p>press a volume key to take a photo </p> <ul style="list-style-type: none"> <li>• <u>Gesture Shutter<sup>2</sup> – take selfies with a simple hand gesture</u></li> <li>• Image Editor – choose from multiple options to enhance your photos such as adding filters and frames, adjusting contrast and brightness, and more</li> <li>• Video Resolutions: full HD up to 1920 x 1080<sup>1</sup></li> <li>• Pause &amp; Resume Recording – pause and start in record mode for one continuous video file</li> <li>• Live Shot – take still shots while recording video</li> <li>• Live Zooming – zoom in/out on videos during playback</li> <li>• Geotagging – include location information with photos and videos</li> </ul> <p><sup>1</sup> Available only on rear-facing camera or camcorder.  <sup>2</sup> Available only on front-facing camera or camcorder. </p> <p>[3]</p>
generating by the module a signal representative of the electromagnetic radiation;	<p>The module of the LG mobile device generates a signal representative of the electromagnetic radiation.</p> <p>For example, the time-of-flight sensor generates a signal responsive to the infrared electromagnetic radiation received from the location or subject at which the front-facing camera is pointed.</p>

	<h2>What is a time-of-flight camera?</h2> <ul style="list-style-type: none"> <li>• Emits an infrared light signal</li> <li>• Measures how long the signal takes to return</li> <li>• Determines depth based on extracted data</li> </ul> <p>A ToF camera uses infrared light (lasers invisible to human eyes) to determine depth information - a bit like how a bat senses its surroundings. The sensor emits a light signal, which hits the subject and returns to the sensor. The time it takes to bounce back is then measured and provides depth-mapping capabilities. This provides a huge advantage over other technologies, as it can accurately measure distances in a <u>complete scene with a single laser pulse.</u></p> <p>[8]</p>
processing said signal to extract information related to intensity of the electromagnetic radiation in the selected location, and	<p>The LG mobile device processes the signal to extract information related to intensity of the electromagnetic radiation in the selected location.</p> <p>For example, the main processor in the mobile device processes the signal to extract information of the infrared electromagnetic radiation, in the location of the time-of-flight sensor or at which the camera is pointed. Both time delay and amplitude (intensity) of the reflected infrared electromagnetic radiation is measured. The amplitude is used as a quality indicator of the data obtained from the reflected IR electromagnetic radiation.</p>



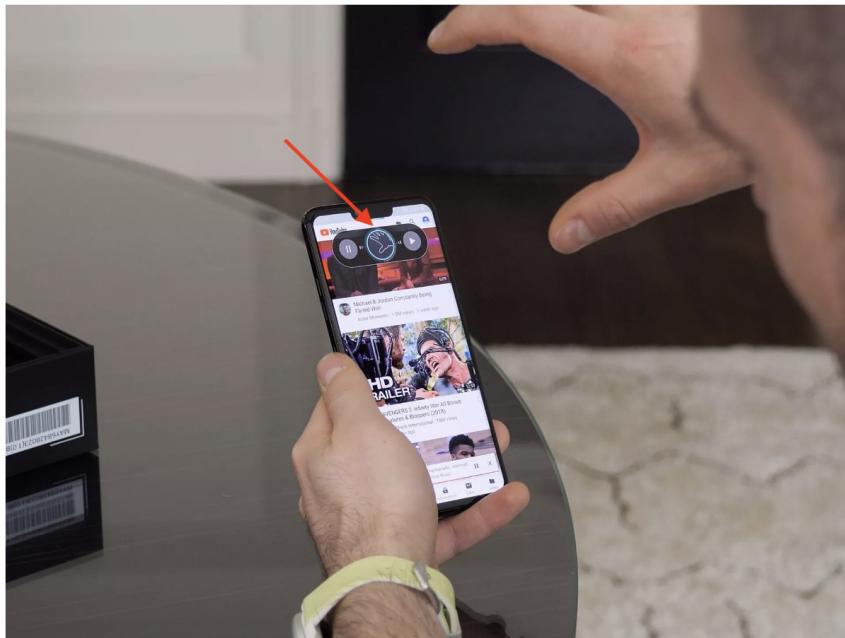
[4]

sending said information to the output means for conveying the information to the operator.

The LG mobile device sends the information to the output means for conveying the information to the operator.  
For example, when using the Air Motion feature of the G8 ThinQ smartphone, a hand guide appears on the display when the mobile device recognizes the hand gesture based on the processed information from the time-of-flight sensor.

## How to use Air Motion on the LG G8

By Hayato Huseman published April 12, 2019



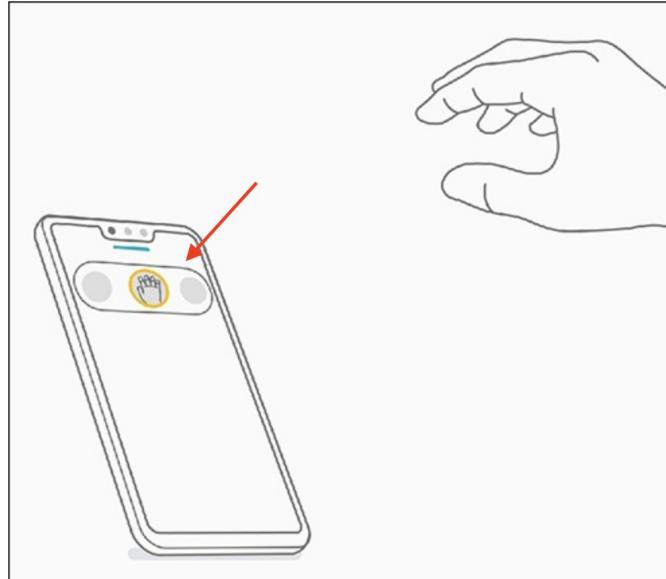
LG G8 Air Motion gestures (Image credit: Android Central)

[6]

c. Wait for the 'hand guide' overlay to appear.



d. Swipe left or right.



[9]

For example, when using the Gesture Shot feature of the LG GPAD 7.0 LTE tablet, a box appears on the display when the mobile device recognizes the hand gesture based on the processed information from the time-of-flight sensor.

## Gesture shot

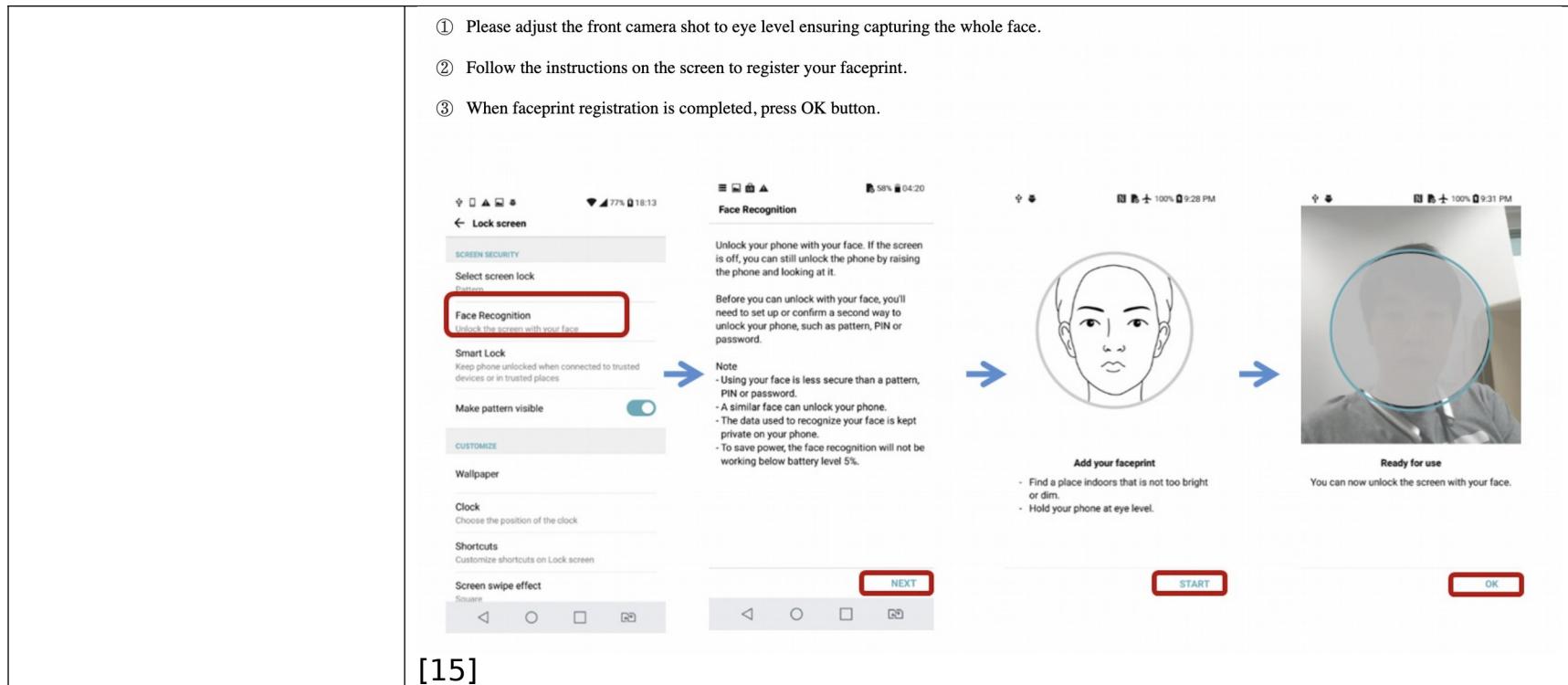
The Gesture shot feature allows you to take a picture with a hand gesture using the front camera.

### To take a photo with a gesture

1. Activate the front camera lens.
2. Raise your hand, with an open palm, until the front camera detects it (a box appears on the screen).
3. Make a fist to start a countdown before the shot is taken (allowing you time to position yourself).

[7]

For example, Face ID for unlocking displays a circle around the image of the user's face on the display after the respective faceprint has been registered.



### Product List:

**Smartphones:** G8 ThinQ, G8 X ThinQ, V50 ThinQ

**Tablets:** G Pad X 8.0 (V520), G Pad 7.0 LTE (LGV411), LG G Pad™ III 8.0 FHD (LGV522), LG G Pad II™ 8.0 LTE (LGV497)

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<https://www.engadget.com/2019-02-20-lg-g8-thinq-gesture-sensor-module.html>

[2] PhoneDB - LG LMG820QM5 G8 ThinQ TD-LTE US G820QM / LMG820QM7D (LG Alpha Prime)  
[https://phonedb.net/index.php?m=device&id=16604&c=lg\\_lmg820qm5\\_g8\\_thinq\\_td-lte\\_us\\_g820qm\\_lmg820qm7d\\_lg\\_alpha\\_prime](https://phonedb.net/index.php?m=device&id=16604&c=lg_lmg820qm5_g8_thinq_td-lte_us_g820qm_lmg820qm7d_lg_alpha_prime)

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<https://mashable.com/article/lg-g8-thinq-hands-on-air-gesture-controls-mwc-2019>

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[11] LG G Pad II™ 8.0 LTE (LGV497)

[https://www.lg.com/ca\\_en/tablet/lg-LGV497-lg-g-pad-8.0-lte](https://www.lg.com/ca_en/tablet/lg-LGV497-lg-g-pad-8.0-lte)

[12] LG G Pad 7.0 LTE (LGV411)

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